(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 3 524 701 B1

(12) EUROPEAN PATENT SPECIFICATION

(45) Date of publication and mention of the grant of the patent:
07.09.2022 Bulletin 2022/36

(21) Application number: **18863803.5**

(22) Date of filing: **25.09.2018**

(51) International Patent Classification (IPC):
C22C 9/04 (2006.01) ***C22C 18/02*** (2006.01)
C22F 1/02 (2006.01) ***C22F 1/08*** (2006.01)
C22F 1/16 (2006.01) ***H01S 3/038*** (2006.01)
C22F 1/00 (2006.01)

(52) Cooperative Patent Classification (CPC):
C22C 9/04; C22C 18/02; C22F 1/02; C22F 1/08; C22F 1/165; H01S 3/0388; H01S 3/2251; H01S 3/2256; Y02E 60/10

(86) International application number:
PCT/JP2018/035491

(87) International publication number:
WO 2019/097846 (23.05.2019 Gazette 2019/21)

(54) CORROSION-RESISTANT CuZn ALLOY

KORROSIONSBESTÄNDIGE CU-ZN-LEGIERUNG

ALLIAGE CuZn RÉSISTANT À LA CORROSION

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR

(30) Priority: **15.11.2017 JP 2017220473**

(43) Date of publication of application:
14.08.2019 Bulletin 2019/33

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Description

TECHNICAL FIELD

[0001] The present invention relates to a corrosion-resistant CuZn alloy that can be suitably used for electrodes employed in an acidic atmosphere.

BACKGROUND ART

[0002] Recently, pulsed laser light has been used for integrated circuit photolithography. The pulsed laser light can be generated by applying gas discharge between a pair of electrodes at very short electric discharge and very high voltage in a gas discharge medium. For example, in ArF laser systems, fluorine-containing plasma is generated between the pair of electrodes during operation. The fluorine-containing plasma is highly corrosive to metals. As a result, the electrodes corrode over time during operation of a pulsed laser generator. The corrosion of the electrodes forms a corrosion spot, which causes arcing in the plasma, thereby further accelerating shortening of an electrode lifetime. For the electrodes, for example, a CuZn alloy is used.

[0003] As a technique for prolonging the electrode lifetime, a technique for stably using an electrode for a long period of time have been developed (Patent Documents 1 and 2), in which a body portion of a discharging electrode made of a CuZn alloy is partially exposed (a discharge receiving area) for discharge and other portions are covered with other alloy. On the other hand, in addition to such improvement of the structure of the electrode, Patent Document 3 discloses a technique for prolonging the electrode lifetime by using phosphorus-doped brass as a copper alloy used for the electrode to reduce generation of micro pores in the brass.

CITATION LIST

Patent Literature

[0004]

Patent Document 1: Japanese Patent Application Publication No. 2007-500942 A
Patent Document 2: Japanese Patent Application Publication No. 2007-510284 A
Patent Document 3: Japanese Patent Application Publication No. 2015-527726 A
Patent Document 4: US 2009/239094 A proposes a Cu-Zn alloy tin plating strip.
Patent Document 5: US 2005/189327 A proposes an electrode wire for electrode discharge machining.
Patent Document 6: US 2012/155501 A proposes angular extrusions of copper alloy anodes.

SUMMARY OF INVENTION

Technical Problem

[0005] Even in the prior arts attempting to prolong the electrode lifetime by improving the structure of the electrode, the electrode lifetime can be further prolonged if corrosion resistance of the CuZn alloy is improved. Further, in the technique for prolonging the lifetime by using phosphorus-doped brass, a burden of an increase in the number of steps is caused due to a step of doping the CuZn alloy with phosphorus to a target concentration, but it is preferable that such a burden can be avoided.

[0006] Thus, an object of the present invention is to provide a CuZn alloy having improved corrosion resistance without adding other elements.

Solution to Problem

[0007] As a result of intensive studies, the present inventors have found that a CuZn alloy having a composition as described below is subjected to hot forging and hot isotropic pressing, thereby exerting improved corrosion resistance without adding other elements, and have arrived at the present invention. The invention is defined in the appended claims.

[0008]

(1) Thus, the present invention a corrosion-resistant CuZn alloy according to claim 1.
(2) The CuZn alloy may have a total content of Zn and Cu which is 99.999% by mass or more.
(3) The CuZn alloy may be an alloy for corrosion-resistant electrodes.
(4) The CuZn alloy may have a number of pores having a pore diameter of 10 μm or more which is 0.1/cm^2 or less based on the optical microscopic observation.
(5) The CuZn alloy may have a content of P of 0.01 ppm or less.
(6) The CuZn alloy may have a content of S of less than 0.05 ppm, a content of Fe of less than 5 ppm, a content of Co of less than 0.05 ppm, a content of Ni of less than 0.1 ppm, a content of As of less than 0.005 ppm, a content of Rh of less than 1 ppm, a content of Ag of less than 1 ppm, a content of Sn of less than 0.5 ppm, a content of Sb of less than 0.005 ppm, a content of Te of less than 0.05 ppm, a content of Tl of less than 3 ppm, a content of Pb of less than 10 ppm, and a content of P of less than 0.05 ppm.

Advantageous Effects of Invention

[0009] According to the present invention, a corrosion-resistant CuZn alloy is obtained. The corrosion-resistant CuZn alloy according to the present invention can be suitably used for electrodes employed in an acidic atmosphere, and is particularly suitable for electrodes of

ArF laser systems and KrF laser systems. The corrosion-resistant CuZn alloy according to the present invention does not require the addition of other elements during the production and can be produced while avoiding the burden of an increase in the number of steps by those addition steps.

BRIEF DESCRIPTION OF DRAWINGS

[0010]

FIG. 1 is an explanatory view of a procedure in Production Example 1.
FIG. 2 is an explanatory view of a procedure in Production Example 2.
FIG. 3 is an explanatory view of procedures in Production Examples 3 and 4.
FIG. 4 is an optical microscope photograph of sample 1.
FIG. 5 is an optical microscope photograph of sample 2.
FIG. 6 is an optical microscope photograph of sample 3.
FIG. 7 is an optical microscope photograph of sample 4.
FIG. 8 is a result of a corrosion resistance test using nitric acid.
FIG. 9 is a result of a corrosion resistance test using an aqueous fluonitric acid solution.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0011] Hereinafter, the present invention will be described in detail by way of embodiments. The present invention is not limited to the specific embodiments as described below.

[Corrosion-Resistance CuZn Alloy]

[0012] A corrosion-resistant CuZn alloy according to the present invention is a CuZn alloy having a Zn content of from 15 to 55% by mass, the balance being Cu and inevitable impurities, wherein a total content of Zn and Cu is 99.995% by mass or more, and wherein a number of pores is 1/cm^2 or less based on optical microscopic observation. The CuZn alloy can be suitably used as an alloy for corrosion-resistant electrodes.

[Zn Content and Cu Content]

[0013] The Zn content can be from 15 to 55% by mass, and preferably from 25 to 45% by mass, and more preferably from 35 to 40% by mass. The total content of the Zn content and the Cu content can be 99.995% by mass or more, and preferably 99.999% by mass or more.

[P Content]

[0014] In the present invention, the content of P as an inevitable impurity of the CuZn alloy may be 0.01 ppm or less. In a preferred embodiment, the P content may be 0.05 ppm or less, or less than 0.05 ppm, and preferably 0.01 ppm or less, and preferably 0.005 ppm or less, or less than 0.005 ppm.

[Inevitable Impurities]

[0015] In the present invention, as the inevitable impurities of the CuZn alloy, the content of each of the following elements can be as follows.

[0016] The S content may be 0.05 ppm or less, and preferably less than 0.05 ppm; the Fe content may be 5 ppm or less, and preferably less than 5 ppm; the Co content may be 0.05 ppm or less, and preferably less than 0.05 ppm; the Ni content may be 0. 1 ppm or less, and preferably less than 0.1 ppm; the As content may be 0.005 ppm or less, and preferably less than 0.005 ppm; the Rh content may be 1 ppm or less, and preferably less than 1 ppm; the Ag content may be 1 ppm or less, and preferably less than 1 ppm; the Sn content may be 0.5 ppm or less, and preferably less than 0.5 ppm; the Sb content may be 0.005 ppm or less; the Te content may be 0.05 ppm or less, and preferably less than 0.05 ppm; the Tl content may be 3 ppm or less, and preferably less than 3 ppm; the Pb content may be 10 ppm or less, and preferably less than 10 ppm; and the P content may be 0.05ppm or less, and preferably less than 0.05ppm.

[Pore]

[0017] In the corrosion-resistant CuZn alloy according to the present invention, the number of pores is 1/cm^2 or less, and preferably 0.1/cm^2 or less, based on optical microscopic observation. An area ratio of the pores at this time is 0.00004%. The number of pores is determined by observing a surface of a sample with an optical microscope, counting the number of pores per a surface of 0.5 mm $\times$ 0.5 mm at arbitrary 10 positions, and calculating an average value thereof. In this case, an observable object as a pore is a pore having a pore diameter of about 10 μm or more as a size of the pore.

[0018] In the corrosion-resistant CuZn alloy according to the present invention, the number of pores having a pore diameter of 10 μm or more is 1/cm^2 or less, and preferably 0.1/cm^2 or less based on optical microscopic observation. The area ratio of the pores is 0.0004% or less, and preferably 0.00004% or less. For the pore diameter of the pore, a circumscribed circle was observed as the pore diameter of the pore, regardless of the shape of the pore.

[Corrosion Resistance]

[0019] The corrosion-resistant CuZn alloy according to the present invention has improved corrosion resistance in a fluorine-containing environment. The corrosion resistance in the present invention can be tested by a fluoronitric acid test described in Examples as severe conditions.

[Production of Corrosion-Resistant CuZn Alloy]

[0020] The corrosion-resistant CuZn alloy according to the present invention can be produced by a production method comprising the steps of: subjecting a CuZn alloy to hot forging, the alloy having a Zn content of from 15 to 55% by mass, the balance being Cu and inevitable impurities, the alloy having a total content of Zn and Cu of 99.995% by mass or more; and subjecting the hot forged CuZn alloy to hot isotropic pressing.

[CuZn Alloy]

[0021] As the CuZn alloy to be subjected to the hot forging, an alloy having the same composition as the above corrosion-resistant CuZn alloy can be used.

[Vacuum Melting]

[0022] In a preferred embodiment, a CuZn alloy obtained by vacuum melting can be used as the CuZn alloy to be subjected to the hot forging. The vacuum melting can be carried out, for example, by maintaining a raw material metal at a temperature in a range of from 900 to 1200 °C, and preferably from 1000 to 1100 °C, under a pressure of from 100 to 600 torr including an inert gas, and preferably from 300 to 500 torr, for 15 to 90 minutes, and preferably for 20 to 60 minutes.

[Hot Forging]

[0023] The hot forging can be carried out, for example, at a temperature in a range of from 600 to 900 °C, and preferably from 700 to 900 °C, such that that a reduction ratio of a cross sectional area of an ingot is from 50 to 80%, and preferably from 60 to 80%. In the hot forging, preheating may be carried out as desired, for example, by heating to the temperature in the above range for 1 to 15 hours.

[Hot Isotropic Pressing]

[0024] The hot isotropic pressing (HIP processing) is carried out in an inert gas, for example in an argon gas, at a temperature in a range of from 450 to 650 °C, and preferably from 500 to 600 °C, for 1 to 8 hours, and preferably 2 to 6 hours, while applying a pressure of from 100 to 200 MPa, and preferably from 120 to 180 MPa.

[Annealing]

[0025] In a preferred embodiment, the CuZn alloy subjected to the hot isotropic pressing may be annealed. The annealing can be carried out, for example, at a temperature in a range of from 500 to 700 °C, and preferably from 550 to 650 °C, for 0.5 to 4 hours, and preferably 1 to 3 hours, by means of air cooling or furnace cooling, or water cooling.

[Finishing]

[0026] In a preferred embodiment, the CuZn alloy subjected to the hot isotropic pressing or the annealed CuZn alloy can be subjected to finishing. The finishing can be performed, for example, by lathe processing.

[Alloy for Corrosion-Resistant Electrode]

[0027] The corrosion-resistant CuZn alloy according to the present invention has improved corrosion resistance in a fluorine-containing environment, so that it can be suitably used as an alloy for corrosion-resistant electrodes. The corrosion-resistant CuZn alloy according to the present invention exerts improved corrosion resistance while avoiding secondary impurity contamination caused by doping treatments for adding other elements, so that it can be used as a highly purity electrode material. The corrosion-resistant CuZn alloy according to the present invention can form an electrode having improved corrosion resistance by using a technique for improving corrosion resistance by improvement of the electrode structure of the prior art.

[0028] Hereinafter, the present invention will be described with reference to Examples. The present invention is not limited to the following Examples.

[Production Example 1] (Example)

[0029] A CuZn alloy was produced as follows.

The following Cu raw materials and Zn raw materials were prepared as raw materials:
Cu raw material: high purity metallic copper (6N) (purity 99.9999%); and
Zn raw material: high purity metal zinc (4N5) (purity 99.995%).

[0030] 28.35 kg of the raw material Cu and 17.15 kg of the raw material Zn were subjected to vacuum melting (conditions: vacuum-drawn to 10^{-1} Pa and then set to 400 torr atmosphere and maintained at 1050 °C for 30 minutes) to obtain a high purity CuZn alloy. An ingot pipping portion at an upper portion of the ingot was removed from the resulting CuZn alloy, and forging was carried out for the ingot having φ 132, a length of 275 mm, and a weight of 31.5 kg.

[0031] Forging was carried out by preheating the ingot at a temperature of 850 °C for 3 hours, and carrying out reheating in four steps of: firstly from φ 135 to φ 130 and then φ 130 → 80 mm square → 50 mm square → φ 41 mm at 850 °C for 10 minutes or more in each step. That is, the hot forging process was conducted by carrying out the reheating at 800 °C for 10 minutes or more every time the forging was performed to draw the ingot in the longitudinal direction so as to reduce the cross sectional area of the ingot to 60 to 80% of the original cross sectional area. After carrying out the forging up to φ 41, the ingot was cut every a length of 650 mm to obtain four forged rods.

[0032] The high purity CuZn alloy thus subjected to the hot forging was subjected to hot isotropic pressing (HIP processing) at 525 °C for 4 hours under Ar of 150 MPa.

[0033] An annealing treatment was then performed by air cooling at 600 °C for 2 hours.

[0034] The high purity CuZn alloy thus processed was subjected to finishing under the following conditions to obtain a high purity CuZn rod (high purity + HIP product) (sample 1).

[0035] An explanatory view of the procedure of Production Example 1 is shown in FIG. 1.

[Production Example 2] (Comparative Example)

[0036] In the same procedure as that of Production Example 1, a Cu raw material and a Zn raw material were prepared and subjected to vacuum melting to obtain a high purity CuZn alloy, which was subjected to hot forging. The high purity CuZn alloy subjected to the hot forging were subjected to finishing under the same conditions as those of Production Example 1, without carrying out hot isotropic pressing (HIP processing), to obtain high purity CuZn rods (high purity products) (sample 2). An explanatory view of the procedure of Production Example 2 is shown in FIG. 2.

[Production Example 3] (Comparative Example)

[0037] A CuZn alloy was produced as follows.

The following Cu raw materials and Zn raw materials were prepared as raw materials: Cu raw material: metallic copper ingot (4N) (purity 99.99%); and
Zn raw material: metallic zinc ingot (3N) (purity 99.9%).

[0038] 28.35 kg of the raw material Cu and 17.15 kg of the raw material Zn were melted in the atmosphere (conditions: maintained at 1050 °C for 30 minutes) to obtain a CuZn alloy. An ingot pipping portion at an upper portion of the ingot was removed from the resulting CuZn alloy, and the ingot having φ 132, a length of 248 mm and a weight of 28.4 kg was extruded.

[0039] The extrusion was carried out using a die having φ 40 such that a finished diameter would be about φ 41, while heating the ingot at 700 °C. An extrusion pressure at this time was from 150 to 170 kg/cm^2. The extruded ingot was cut on the extruder outlet side every 650 mm to obtain four alloy rods (sample 3).

[Production Example 4] (Comparative Example)

[0040] In the same procedure as that of Production Example 3, a Cu raw material and a Zn raw material were prepared and melted in the atmosphere to obtain a CuZn alloy.

[0041] Forging was carried out by preheating the ingot at a temperature of 850 °C for 3 hours, and carrying out reheating in four steps of: firstly from φ 135 to φ 130 and then φ 130 → 80 mm square → 50 mm square → φ 41 mm at 850 °C for 10 minutes or more in each step. That is, the hot forging process was conducted by carrying out the reheating at 800 °C for 10 minutes or more every time the forging was performed to draw the ingot in the longitudinal direction so as to reduce the cross sectional area of the ingot to 60 to 80% of the original cross sectional area. After carrying out the forging up to φ 41, the ingot was cut every a length of 650 mm to obtain four forged rods (sample 4).

[0042] An explanatory view of the procedures of Production Examples 3 and 4 is shown in FIG. 3.

[Composition Analysis]

[0043] For the compositions of samples 1 to 4, the metallic elements were analyzed by GD-MS (VG 9000 available from VG Scientific), and the gas components was analyzed by an oxygen/nitrogen analyzer (Model TCH-600) available from LECO for oxygen (O), nitrogen (N) and hydrogen (H), and analyzed by a carbon sulfur analyzer (Model CS-444) available from LECO for carbon (C) and sulfur (S). The results obtained are shown in Table 1 (Table 1-1, and Table 1-2) as described below. For units in the table, those expressed in wt% means % by mass, and those with no specific description means ppm. It should be noted that samples were prepared as described in the procedures of the Production Examples as described above, and samples 1 and 2 were made from the same ingot, and samples 3 and 4 were made from the same ingot.

[Table 1-1]

	Samples 3 and 4	Samples 1 and 2
Li	< 0.001	< 0.001
Be	0.07	< 0.001
B	0.89	< 0.001
F	< 0.01	< 0.01
Na	< 0.01	< 0.01
Mg	17	< 0.001
Al	0.21 wt%	< 0.001
Si	22	< 0.005
P	44	< 0.005
S	4.2	< 0.05
Cl	< 0.005	< 0.005
K	< 0.01	< 0.01
Ca	< 0.005	< 0.005

(continued)

	Samples 3 and 4	Samples 1 and 2
Sc	< 0.001	< 0.001
Ti	0.47	< 0.001
V	0.09	< 0.001
Cr	27	0.06
Mn	14	0.06
Fe	490	0.75
Co	3.3	0.003
Ni	320	0.05
Cu	Matrix	Matrix
Zn	Matrix	Matrix
Ga	0.64	< 0.05
Ge	3.3	< 0.1
As	2.1	< 0.005
Se	0.21	< 0.01
Br	< 0.05	< 0.05
Rb	0.005	< 0.001
Sr	0.005	< 0.001
Y	0.01	< 0.001
Zr	5.7	< 0.001
Nb	2.0	< 0.005
Mo	0.40	< 0.005
Ru	< 0.1	< 0.1
Rh	< 1	< 1
Pd	< 0.5	< 0.5
Ag	29	0.50

[Table 1-2] (Continued)

Cd	11	0.08
In	11	< 0.05
Sn	0.10wt%	< 0.005
Sb	58	0.005
Te	0.52	< 0.05
I	< 0.1	< 0.1
Cs	< 0.05	< 0.05
Ba	< 0.005	< 0.005
La	< 0.001	< 0.001
Ce	< 0.001	< 0.001
Pr	< 0.001	< 0.001
Nd	< 0.05	< 0.05
Sm	< 0.005	< 0.005
Eu	< 0.001	< 0.001
Gd	< 0.001	< 0.001
Tb	< 0.001	< 0.001
Dy	< 0.001	< 0.001
Ho	< 0.001	< 0.001
Er	< 0.005	< 0.005
Tm	< 0.005	< 0.005
Yb	< 0.001	< 0.001
Lu	< 0.001	< 0.001

(continued)

Hf	< 0.001	< 0.001
Ta	< 1	< 1
W	< 0.005	< 0.005
Re	< 0.005	< 0.005
Os	< 0.001	< 0.001
Ir	0.006	< 0.005
Pt	< 0.05	< 0.05
Au	< 0.1	< 0.1
Hg	< 0.01	< 0.01
Tl	1.5	1.0
Pb	2.1wt%	3.1
Bi	15	< 0.001
Th	< 0.001	< 0.001
U	< 0.001	< 0.001
C	37	<1
N	16	<1
O	12	<1
H	6	<1

[Microscopic Observation]

[0044] Samples 1 to 4 were observed under an optical microscope (observation conditions: polished up to # 2000 with abrasive paper, then subjected to buffing, and observed using equipment: Nikon ECLIPSEMA 200; magnifications of 100 and 400). The resulting photographs are shown in FIGS. 4 to 7.

[0045] Based on the microscopic observation, the number of pores per a surface of 0.5 mm x 0.5 mm was counted at 10 positions, and an average value thereof was calculated. The counting was carried out by counting the number of pores with visual observation for the two positions for each sample, and counting the number of pores to determine a binarization threshold (80 in 256 steps) so as to match the counts with the visual observation from those results, and for the remaining eight positions, counting the number of pores by image processing based on the binarization threshold.

[0046] In sample 1, the number of pores per a surface 0.5 mm x 0.5 mm was about zero. The area ratio of the pores was 0.0000%.

[0047] In sample 2, the number of pores per a surface of 0.5 mm x 0.5 mm was 5 or less. The area ratio of the pores was 0.0024%.

[0048] In sample 3, the number of pores per a surface of 0.5 mm x 0.5 mm was 1000 or more. The area ratio of the pores was 0.7884%.

[0049] In Sample 4, the number of pores per a surface of 0.5 mm x 0.5 mm was 100 or more, and the presence of large pores having a pore diameter of 10 μm or more was observed. The area ratio of the pores was 0.1649%.

[0050] Thus, in sample 1 obtained by subjecting the high purity CuZn to the hot forging and HIP processing, no pore was observed in observation with the optical microscope. In sample 2 obtained by subjecting the high purity CuZn to the hot forging, only very few pores were observed in observation with the optical microscope. However, sample 3 obtained by subjecting the CuZn alloy having a degree of purity of a commercially available product to the hot rolling/hot extruding and cold drawing had a very large number of pores. Sample 4 obtained by subjecting the CuZn alloy having a degree of purity of a commercial product to the hot forging had a smaller number of pores than that of sample 3, but it had a very larger number of pores than that of sample 2, and the presence of large pores were observed.

[Corrosion Resistance Test]

[Nitric Acid Test]

[0051] The corrosion resistance test using nitric acid was carried out in the following procedure: 8.4 g of each of samples 1 to 4 (each size: 10 mm x 10 mm x 10 mm) was prepared. An aqueous nitric acid solution was prepared by mixing 80 ml of nitric acid (65%) with 420 ml of pure water. Each of samples 1 to 4 was added to 500 ml of the aqueous nitric acid solution, and measured for weight loss after 10 minutes, 30 minutes and 60 minutes of the addition, with stirring at 25 °C, to calculate a dissolved amount (mg/cm^2) for each of the above times. The results of the corrosion resistance test using nitric acid are shown in FIG. 8.

[Fluonitric Acid Test]

[0052] The corrosion resistance test using fluonitric acid was carried out in the following procedure:
8.4 g of each of samples 1 to 4 (each size: 10 mm x 10 mm $\times$ 10 mm) was prepared. An aqueous fluonitric acid solution was prepared by mixing 20 ml of hydrofluoric acid (46%), 60 ml of nitric acid (65%) and 420 ml of pure water. Each of samples 1 to 4 was added to 500 ml of the aqueous fluonitric acid solution, and measured for weight loss after 10 minutes, 30 minutes and 60 minutes of the addition, with stirring at 25 °C, to calculate a dissolved amount (mg/cm^2) for each of the above times. The results of the corrosion resistance test using the aqueous fluonitric acid solution are shown in FIG. 9.

[0053] Thus, in sample 3 (Comparative Example) and sample 4 (Comparative Example) each having the larger number of pores, the dissolution rapidly progressed in both the nitric acid test and the fluonitric acid test in the same manner. On the other hand, in sample 2 (Comparative Example) having the decreased number of pores as compared with samples 3 and 4, the dissolution was reduced in both the nitric acid test and the fluonitric acid test. For example, after 60 minutes of the nitric acid test, a ratio of the dissolved amount of sample 2 to that of sample 3 was 1/2.85. For example, after 60 minutes of the fluonitric acid test, the ratio of the dissolved amount of sample 2 to that of sample 3 was 1/2.46. On the other hand, in sample 1 (Example) in which substantially no pore was observed, the dissolution was extremely reduced in both the nitric acid test and the fluonitric acid test. For example, after 60 minutes of the nitric acid test, the ratio of the dissolved amount of sample 1 to that of sample 3 was 1/4.83. For example, after 60 minutes of the fluonitric acid test, the ratio of the dissolved amount of sample 1 to that of sample 3 was 1/8.92. Also, after 60 minutes of the nitric acid test, the ratio of the dissolved amount of sample 1 to that of sample 2 was 1/1.69. For example, after 60 minutes of the fluonitric acid test, the ratio of the dissolved amount of sample 1 to that of sample 2 was 1/3.63.

INDUSTRIALAPPLICABILITY

[0054] The present invention provides a corrosion-resistant CuZn alloy. The present invention is an industrially useful invention.

Claims

1. A corrosion-resistant CuZn alloy, the alloy having a Zn content of from 15 to 55% by mass, the balance being Cu and inevitable impurities,

    wherein a total content of Zn and Cu is 99.995% by mass or more, and
    characterised in that a number of pores having a diameter of 10 μm or more in the CuZn alloy is 1/cm^2 or less based on an optical microscopic observation performed by: observing a 0.5 mm $\times$ 0.5 mm surface of a sample of the CuZn alloy with an optical microscope, counting the number of pores having a diameter of 10 μm or more at 10 arbitrary positions on the surface, and calculating an average value thereof.

2. The CuZn alloy according to claim 1, wherein the total content of Zn and Cu is 99.999% by mass or more.

3. The CuZn alloy according to claim 1 or 2, wherein the CuZn alloy is an alloy for corrosion-resistant electrodes.

4. The CuZn alloy according to any one of claims 1 to 3, wherein the number of pores having a pore diameter of 10 μm or more is 0.1/cm^2 or less based on the optical microscopic observation.

5. The CuZn alloy according to any one of claim 1 to 4, wherein the CuZn alloy has a content of P of 0.01 ppm or less.

6. The CuZn alloy according to any one of claims 1 to 4, wherein the CuZn alloy has a content of S of less

than 0.05 ppm, a content of Fe of less than 5 ppm, a content of Co of less than 0.05 ppm, a content of Ni of less than 0.1 ppm, a content of As of less than 0.005 ppm, a content of Rh of less than 1 ppm, a content of Ag of less than 1 ppm, a content of Sn of less than 0.5 ppm, a content of Sb of 0.005 ppm or less, a content of Te of less than 0.05 ppm, a content of Tl of less than 3 ppm, a content of Pb of less than 10 ppm, and a content of P of less than 0.05 ppm.

Patentansprüche

1. Korrosionsbeständige CuZn-Legierung, wobei die Legierung einen Zn-Gehalt von 15 bis 55 Massen-% aufweist und der Rest Cu und unvermeidbare Verunreinigungen ist,

   wobei ein Gesamtgehalt von Zn und Cu 99,995 Massen-% oder mehr beträgt, und **dadurch gekennzeichnet, dass** eine Anzahl von Poren mit einem Durchmesser von 10 μm oder mehr in der CuZn-Legierung basierend auf der Beobachtung mit einem optischen Mikroskop, die durch Beobachten einer Fläche von 0,5 mm x 0,5 mm einer Probe der CuZn-Legierung mit einem optischen Mikroskop, durch Zählen der Anzahl von Poren mit einem Durchmesser von 10 μm oder mehr an 10 zufälligen Positionen auf der Fläche und durch Berechnen eines Mittelwerts daraus durchgeführt wurde, 1/cm^2 oder weniger beträgt.

2. CuZn-Legierung nach Anspruch 1, wobei der Gesamtgehalt von Zn und Cu 99,999 Massen-% oder mehr beträgt.

3. CuZn-Legierung nach Anspruch 1 oder 2, wobei die CuZn-Legierung eine Legierung für korrosionsbeständige Elektroden darstellt.

4. CuZn-Legierung nach einem der Ansprüche 1 bis 3, wobei die Anzahl von Poren mit einem Porendurchmesser von 10 μm oder mehr basierend auf der Beobachtung mit dem optischen Mikroskop 0,1/cm^2 oder weniger beträgt.

5. CuZn-Legierung nach einem der Ansprüche 1 bis 4, wobei die CuZn-Legierung einen P-Gehalt von 0,01 ppm oder weniger aufweist.

6. CuZn-Legierung nach einem der Ansprüche 1 bis 4, wobei die CuZn-Legierung einen S-Gehalt von weniger als 0,05 ppm, einen Fe-Gehalt von weniger als 5 ppm, einen Co-Gehalt von weniger als 0,05 ppm, einen Ni-Gehalt von weniger als 0,1 ppm, einen As-Gehalt von weniger als 0,005 ppm, einen Rh-Gehalt von weniger als 1 ppm, einen Ag-Gehalt von weniger als 1 ppm, einen Sn-Gehalt von weniger als 0,5 ppm, einen Sb-Gehalt von 0,005 ppm oder weniger, einen Te-Gehalt von weniger als 0,05 ppm, einen Tl-Gehalt von weniger als 3 ppm, einen Pb-Gehalt von weniger als 10 ppm und einen P-Gehalt von weniger als 0,05 ppm aufweist.

Revendications

1. Alliage CuZn résistant à la corrosion, l'alliage présentant une teneur en Zn de 15 à 55 % en masse, le reste étant du Cu et des impuretés inévitables,

   dans lequel une teneur totale en Zn et Cu est supérieur ou égale à 99,995 % en masse, et **caractérisé en ce qu'**un nombre de pores présentant un diamètre supérieur ou égal à 10 μm dans l'alliage CuZn est inférieur ou égal à 1/cm^2 sur la base d'une observation microscopique optique effectuée par les étapes consistant à : observer une surface de 0,5 mm x 0,5 mm d'un échantillon de l'alliage CuZn à l'aide d'un microscope optique, compter le nombre de pores présentant un diamètre supérieur ou égal à 10 μm dans 10 positions arbitraires sur la surface, et calculer une valeur moyenne de ceux-ci.

2. Alliage CuZn selon la revendication 1, dans lequel la teneur totale en Zn et Cu est supérieur ou égale à 99,999 % en masse.

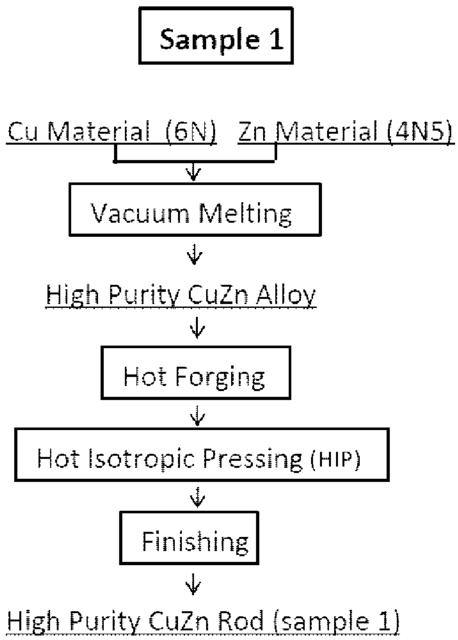
3. Alliage CuZn selon la revendication 1 ou 2, dans lequel l'alliage CuZn est un alliage pour des électrodes résistant à la corrosion.

4. Alliage CuZn selon l'une quelconque des revendications 1 à 3, dans lequel le nombre de pores présentant un diamètre de pore supérieur ou égal à 10 μm est inférieur ou égal à 0,1/cm^2 sur la base de l'observation microscopique optique.

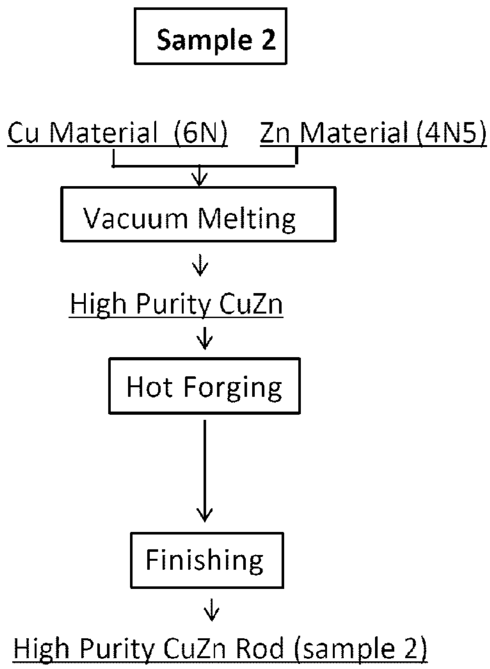
5. Alliage CuZn selon l'une quelconque des revendications 1 à 4, dans lequel l'alliage CuZn présente une teneur en P inférieure ou égale 0,01 ppm.

6. Alliage CuZn selon l'une quelconque des revendications 1 à 4, dans lequel l'alliage CuZn présente une teneur en S inférieure à 0,05 ppm, une teneur en Fe inférieure à 5 ppm, une teneur en Co inférieure à 0,05 ppm, une teneur en Ni inférieure à 0,1 ppm, une teneur en As inférieure à 0,005 ppm, une teneur en Rh inférieure à 1 ppm, une teneur en Ag inférieure à 1 ppm, une teneur en Sn inférieure à 0,5 ppm, une teneur en Sb inférieure ou égale à 0,005 ppm, une teneur en Te inférieure à 0,05 ppm, une teneur en Tl inférieure à 3 ppm, une teneur en Pb inférieure à 10 ppm, et une teneur en P inférieure à 0,05 ppm.

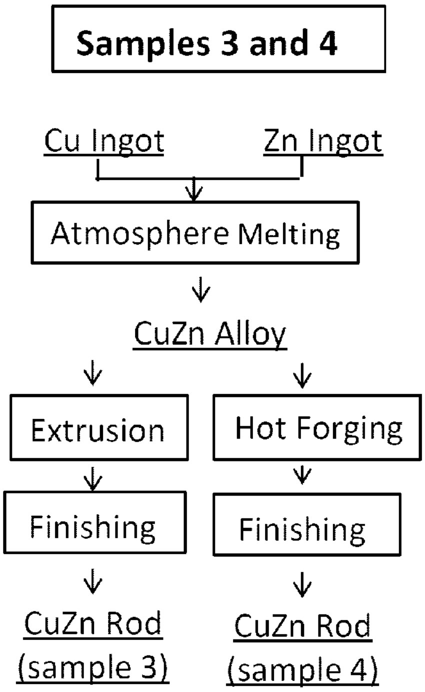
[FIG. 1]


Sample 1
Cu Material (6N)
Zn Material (4N5)
Vacuum Melting
High Purity CuZn Alloy
Hot Forging
Hot Isotropic Pressing (HIP)
Finishing
High Purity CuZn Rod (sample 1)

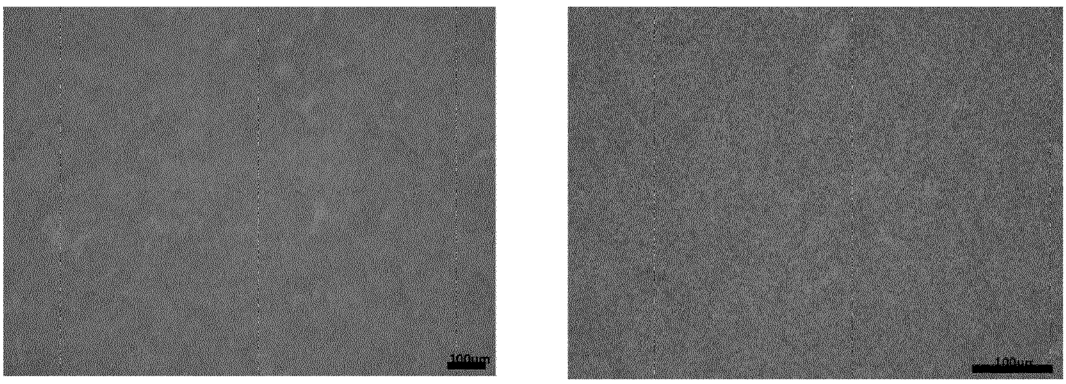
[FIG. 2]


Sample 2
Cu Material (6N)
Zn Material (4N5)
Vacuum Melting
High Purity CuZn
Hot Forging
Finishing
High Purity CuZn Rod (sample 2)

[FIG. 3]

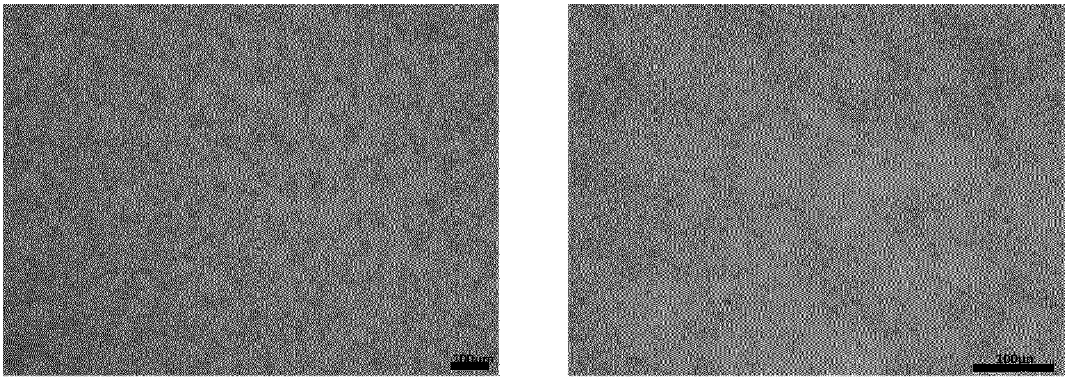


[FIG. 4]



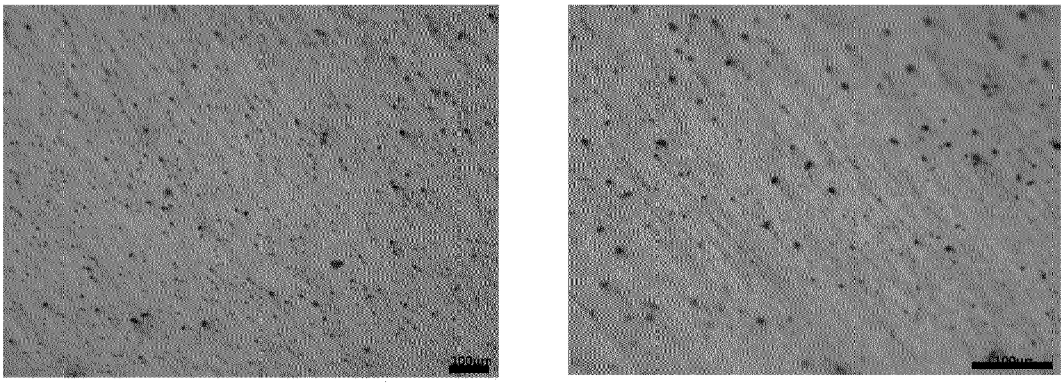
sample 1 left x100, right x400

[FIG. 5]



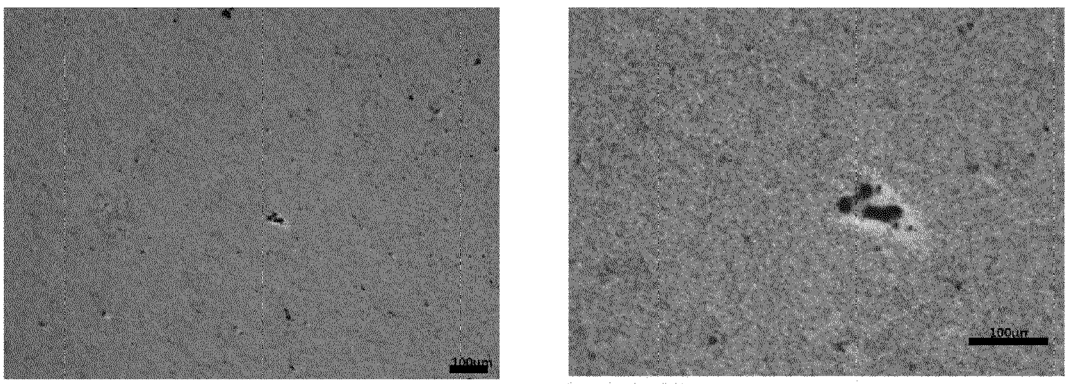
sample 2 left x100, right x400

[FIG. 6]



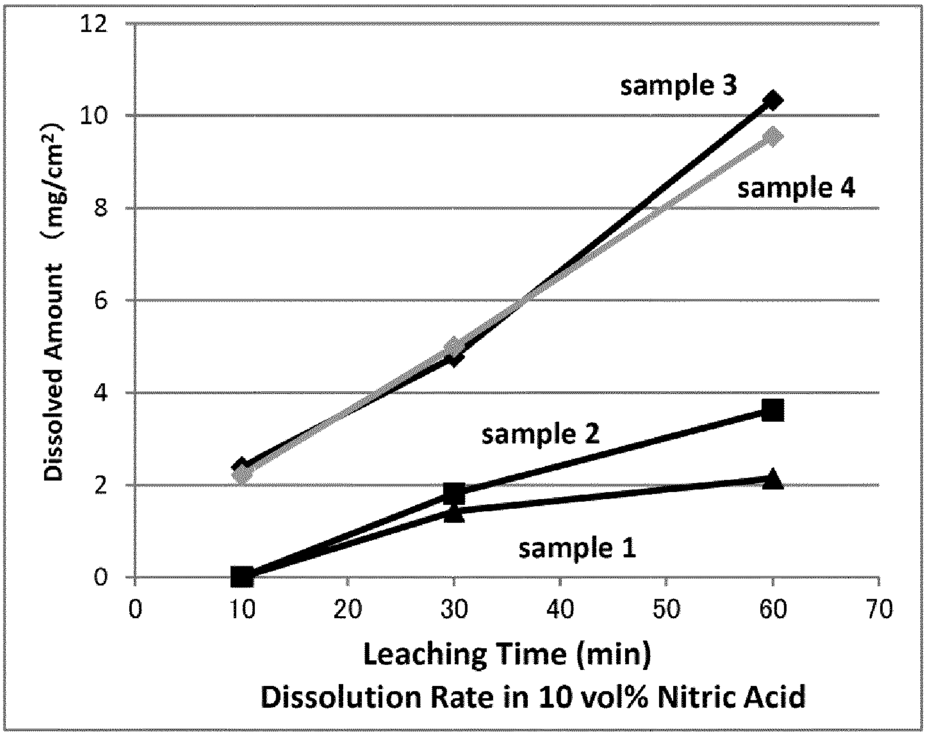
sample 3 Left x100, Right x400

[FIG. 7]



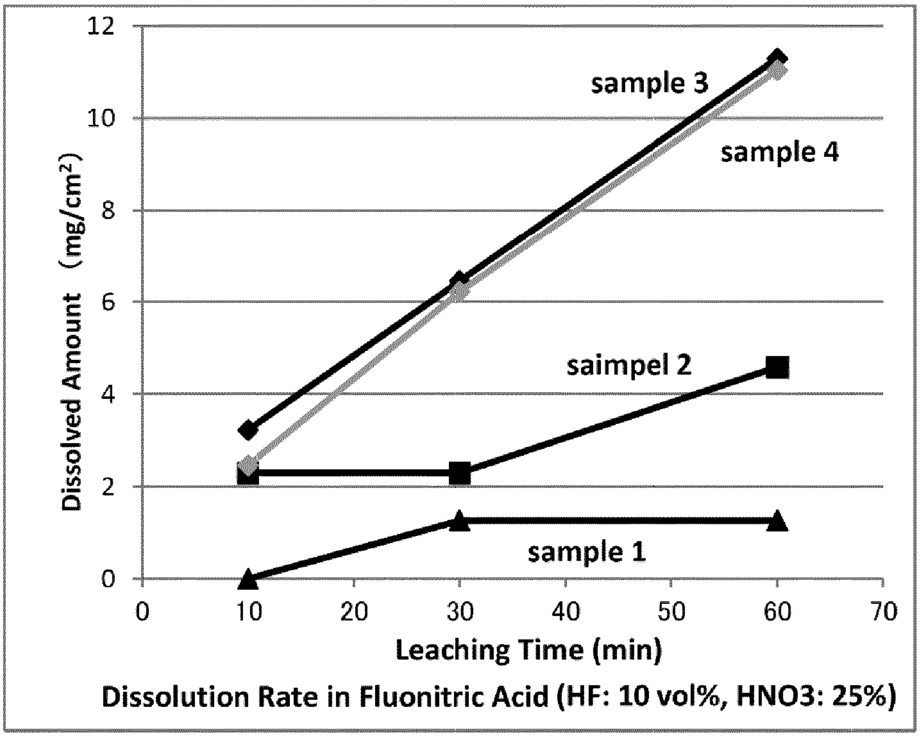
sample 4 Left x100, right x400

[FIG. 8]



Dissolved Amount (mg/cm²)
12
10
8
6
4
2
0
0
10
20
30
40
50
60
70
sample 3
sample 4
sample 2
sample 1
Leaching Time (min)
Dissolution Rate in 10 vol% Nitric Acid

[FIG. 9]



Dissolved Amount (mg/cm²)
12
10
8
6
4
2
0
0
10
20
30
40
50
60
70
sample 3
sample 4
saimpel 2
sample 1
Leaching Time (min)
Dissolution Rate in Fluonitric Acid (HF: 10 vol%, HNO3: 25%)

REFERENCES CITED IN THE DESCRIPTION

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